NATIONAL PETROLEUM RESERVE IN ALASKA

GEOLOGICAL REPORT

SOUTH BARROW WELL NO. 15

HUSKY OIL NPR OPERATIONS, INC.
Prepared by: R. G. Brockway

For the

U. S. GEOLOGICAL SURVEY
Office of the National Petroleum Reserve in Alaska
Department of the Interior
AUGUST 1983

TABLE OF CONTENTS

PERTINENT DATA AND ANALYSIS (Continued)

GEOLOGIC SUMMARY

INTRODUCTION

The South Barrow Well No. 15, 2640' FEL and 990' FNL, protracted Section 23, T22N, R17W, Umiat Meridian, is approximately 10 miles southeast of Barrow, Alaska (Figures 1, 2, and 3). It was drilled in an effort to extend the East Barrow Gas Field in a northerly direction. Drilling below conductor casing began on August 23, 1980 and Cretaceous and Late Jurassic age rocks were drilled. The well terminated as a producible gas well in Lower Jurassic(?) strata at a total depth of 2,278 feet on September 10, 1980.

Six conventional cores were cut. Four drill-stem tests (including 2 misruns) and one production test were undertaken.

In each of the South Barrow wells drilled after No. 13, an inhibitive mud system, containing calcium chloride, was used below the intermediate casing (commonly 9-5/8" to about 1500'). This was done to minimize damage to potential reservoirs caused by swelling clays, which are present in the Barrow sandstones and Sag River Sandstone (determined by water-susceptibility tests on cores from South Barrow Nos. 12 and 13). The high concentrations of calcium chloride (68,000 to 118,000 ppm) used in the drilling mud below intermediate casing necessitated running a dual laterolog as the high calcium- and chloride-ion concentration in the mud adversely affects the conductivity measurement by the daul induction log. The dual induction log was run in the upper part of each well where fresh-water mud was used.

PRE-DRILLING PROGNOSIS

Primary objective of the well was the Lower Barrow sandstone. Approximately 20-25 feet of good porous sandstone was expected at a depth of approximately 2060'. Secondary objectives were the Upper Barrow sandstone and possibly thin sandstones in the lower "Pebble Shale".

POST-DRILLING SUMMARY

Results obtained from the drilling of the South Barrow Well No. 15 proved to be disappointing as it was discovered that the Lower Barrow sandstone was 128 feet lower than indicated by prognosis and 153 feet lower than South Barrow Well No. 19, approximately one-half mile to the southeast.

Because the South Barrow Well No. 15 is so much lower than other wells in the field, it is concluded that a fault must pass between Wells Nos. 15 and 19.

The Lower Barrow sandstone (primary objective) had porosities of 15-18%, but it computed to be water wet. This was confirmed by Drill-Stem Test No. 4 (2188-2278'), which recovered 2090' of formation water.

The Upper Barrow sandstone, with porosities of 11.1 to 24.4% but generally low permeabilities, contained fair to good hydrocarbon shows. Drill-Stem Test No. 3, through perforations 2105-2136', recovered gas at a calculated rate of 500 MCFGPD. A production test through perforations (2054-2064', 2110-2151') in the Upper Barrow and a sandstone in the Kingak recovered 1.0 MMCFGPD.

This well was completed as a gas well in the Upper Barrow sandstone.

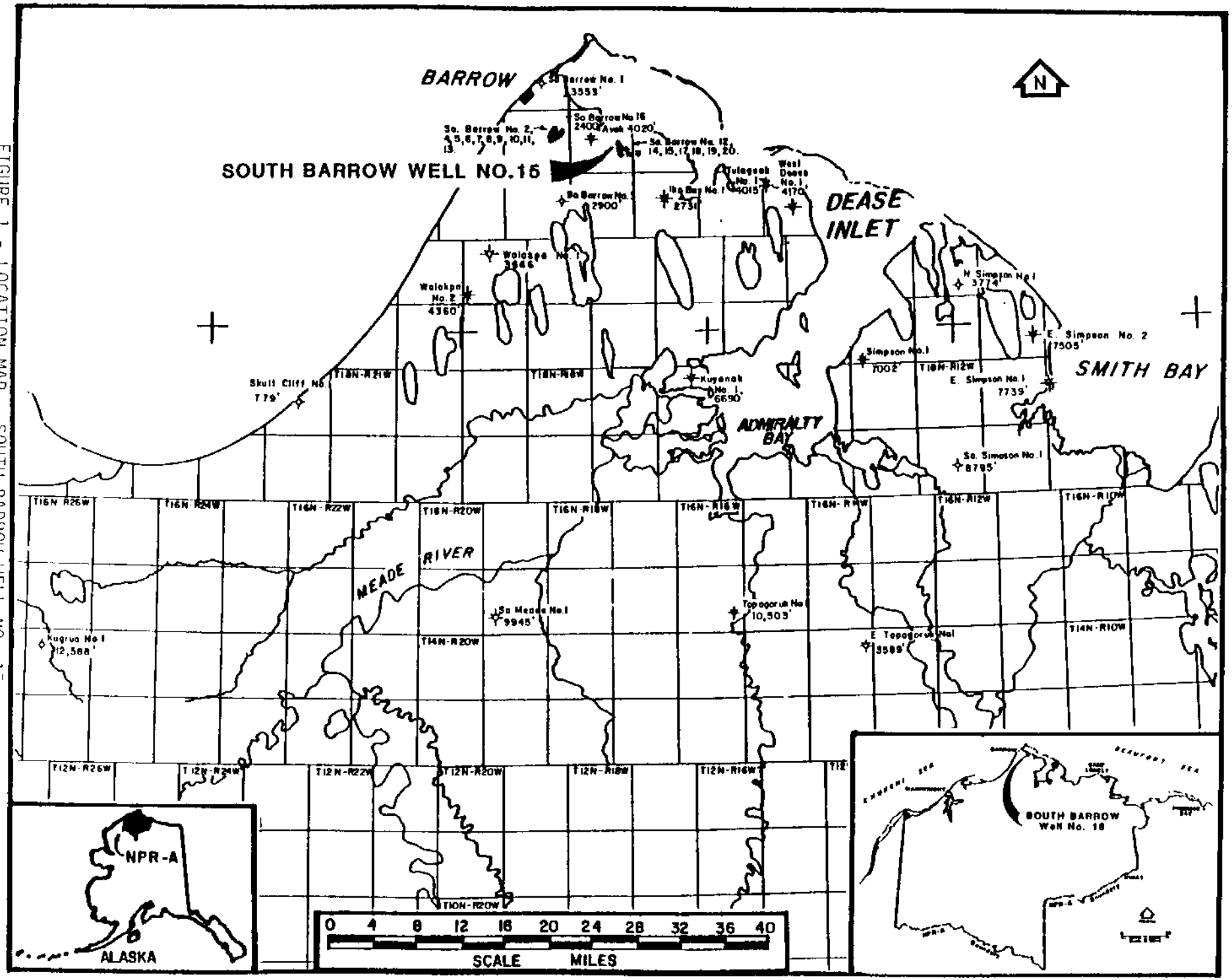
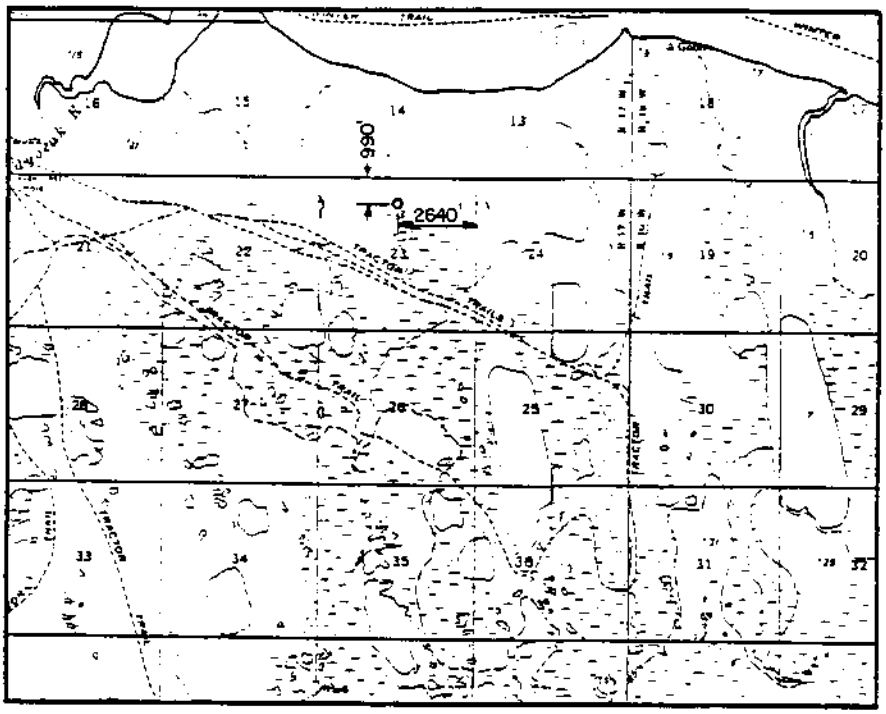


FIGURE 1 - LOCATION MAP - SOUTH BARROW WELL NO. 15



0 1/2 1 2
SCALE IN MILES

BARROW GAS WELL No. 15
LAT. = 71° 14' 58.68"
LONG. = 156° 20' 42.13"
Y = 6,309,541.29
X = 694,843.94
ZONE 6

CERTIFICATE OF SURVEYOR

I hereby certify that I am properly registered and licensed to practice land surveying in the State of Alaska and that this plat represents a location survey made by me or under my supervision, and that all dimensions and other details are correct.

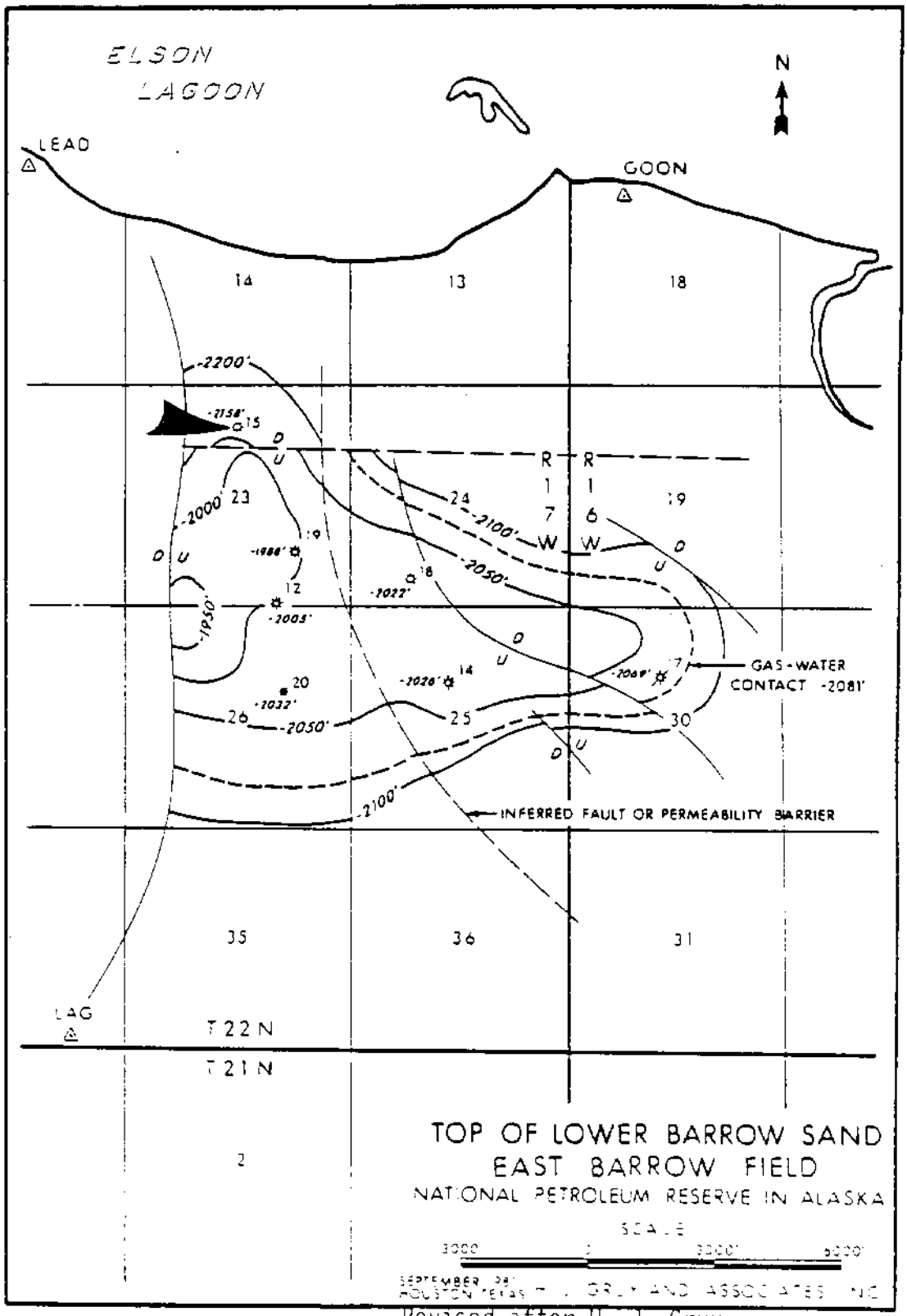
STATE OF ALASKA
49TH
James L. Roberts
No. 3260-S
REGISTERED PROFESSIONAL LAND SURVEYOR

AS STAKED
BARROW GAS WELL No. 15
LOCATED IN
NE 1/4 PROTRACTED SEC. 23 T22N, R17W, UMIAT MERIDIAN, AK.

SURVEYED FOR
HUSKY OIL
N.P.R. OPERATIONS, INC.

TECTONICS INC.
P.O. BOX 4-2285, ANCHORAGE, AK 99509

FIGURE 2 - CERTIFICATE OF SURVEYOR - SOUTH BARROW WELL NO. 15



Revised after H. J. Gruy

FIGURE 3 - STRUCTURE, TOP OF LOWER BARROW SAND

WELLSITE GEOLOGIST'S REPORT
BY: R. G. BROCKWAY

INTRODUCTION

The South Barrow Well No. 15, was drilled approximately 10 miles southeast of Barrow, Alaska. Primary objectives of the well were the Barrow sandstones, particularly the Lower Barrow, which is the main producing sandstone of the East Barrow Gas Field.

Upon drilling the well, it was discovered that No. 15 was 155' lower than South Barrow Well No. 19 at the top of the Upper Barrow sandstone. It was then concluded that these two wells are separated by a fault.

Porous zones were observed in both the Upper and Lower Barrow sandstones. Hydrocarbon shows were fair to good in the Upper Barrow with only a trace in the Lower Barrow. Porosities varied from 11.1% to 24.4% in the Upper Barrow. A production test of the Upper Barrow recovered 1.0 MMCFGPD. The Lower Barrow had fair porosities, but computed to be water wet.

STRATIGRAPHY

WIRELINE TOPS

	Drilled Depth (BKB)	Subsea KB 30'
CRETACEOUS		
Torok Formation	110'	-80'
	Samples start	
"Pebble Shale"	1480'	-1450'
JURASSIC		
Kingak Formation	1911'	-1881'
Upper Barrow sandstone	2107'	-2077'
Lower Barrow sandstone	2188'	-2158'
Total Depth	2278'	-2248'

CRETACEOUS

Torok Formation: 110-1480'

Samples throughout the Torok Formation were very poor or missing. The sediments are very susceptible to water, and water without additives was used to drill the upper 1510' of South Barrow Well No. 15. Nearly all the samples went into suspension and through the shaker screens.

With the use of electric logs and those samples that were obtained, it appears that the upper 700' of the formation consists of interbedded

siltstones, claystones and sandstones, with the sandstones and siltstones most prominent. One zone from 372-505' appears to be a sandstone section with interbedded siltstone and claystone stringers.

A light tannish-gray, sandy siltstone with coal chips, scattered light and dark gray chert pebbles and Inoceramus fragments, was present to a depth of 250'. From 250-373', the samples were primarily sandstone with brownish-gray, very argillaceous limestone. These sandstones are light to medium gray, very fine to fine grained, subangular, slightly carbonaceous, partly very carbonaceous on what appears to be bedding planes, very calcareous, micaceous and have scattered fossil fragments. The limestone probably occurs as thin interbeds in the sandstone. Electric logs indicate the presence of possible siltstones and claystones, although they were not present in the samples.

In the interval 373-505', sandstones were observed which were light to medium gray, very fine to medium grained, with the medium grained sand in the upper 25', very clayey to very calcareous, subangular, with scattered limestone nodules and coal stringers. Traces of siltstone and shale were observed in the samples. A few chips contained calcite crystals on what appeared to be fracture faces. The interval 505' to 700' appears on the logs to be thin bedded sandstones, siltstones and claystones. Only very light to medium gray, very fine grained sandstone and some very argillaceous limestone were present in the cuttings. A trace of gray argillaceous siltstone was observed, which increased slightly in the interval 700-800'.

At 800', Core No. 1 (800-825') was cut, and 9' of brownish-gray, very soft, flaky micromicaceous shale was recovered. A few very silty streaks and rare sandstone inclusions and partings occurred.

Below 825', samples were very poor or unobtainable, but the drilling mud was composed of a very high percentage of fine silt. Shales from Core No. 1 were very susceptible to water, so it is assumed that the interval 800-1329' is composed of very soft clayey siltstones and soft silty claystones or shales, with occasional sandstone beds and partings. These assumptions are supported by the electric-log responses.

Core No. 2 (1329-1389') was taken in an effort to recover the contact of the Torok Formation and the "Pebble Shale". Recovered in this core were thin bedded and interlaminated dark brown, silty, "poker chip" shales, brown micaceous siltstone and dark to light brown, very fine to fine grained, subangular, very shaly and silty sandstones with hydrocarbon shows. The contact was not present.

Samples below 1389' to a depth of 1480' were also very poor, but are probably similar to the strata found in Core No. 2. Rare chips of light brownish-gray, slightly carbonaceous siltstone were present in the drilling mud through this interval.

"Pebble Shale": 1480-1911'

The "Pebble Shale" is composed of dark gray to dark brownish-gray, fissile, carbonaceous, micromicaceous shales with some siltstone stringers and thin light gray bentonites and bentonitic shale in the upper 110'. Scattered throughout the shales are rounded quartz grains, dark chert granules and very fine crystalline pyrite inclusions.

Below 1590', there is an increase in siltstone and sandstone interbeds and a decrease in bentonitic material. The siltstones are brownish-gray to dark gray, partly carbonaceous, shaly, soft to moderately hard and generally very thin bedded. The sandstones, in beds up to 5' thick, are light brownish-gray to medium gray, very fine to fine grained, subangular, occasionally partly subrounded, slightly silty and clayey with argillite and carbonaceous grains and scattered glauconite grains. Light and dark chert pebbles and rounded quartz grains increase slightly in abundance in a downward direction. Porosity in the sandstones reaches a high of approximately 18% (Density porosity log) with hydrocarbon shows present in all the sands.

In an effort to cut the Cretaceous-Jurassic contact, Core No. 3 (1838-1881') was taken, but did not recover the contact. Interbedded siltstones and sandstones were recovered in the interval 1838-1872'. The siltstones are dark brown, sandy and shaly, and the sandstones are brown to dark brown, very fine to fine grained, subangular and slightly glauconitic and contain fair to good hydrocarbon shows. Sandstone beds obtain thicknesses of 2'. The lower 6.8' of the core is gray-brown fissile shale with fish fragments. Rounded light and dark chert granules and pebbles and rounded quartz grains are scattered to common throughout.

At 1900', a thin, sandy, "salt and pepper" chert and quartz pebble conglomerate was encountered in the drill cuttings. This has been designated as the basal "Pebble Shale" conglomerate. The Cretaceous-Jurassic contact has been placed at the base of the conglomerate at 1911'.

JURASSIC

Kingak Formation: 1911-2278'

The Jurassic Kingak Formation, to a depth of 2058', is composed of interbedded siltstones and shales with occasional sandstone stringers. The siltstones are light brownish-gray, soft, carbonaceous, with a trace of glauconite grains and pellets. The shales, varying in color from light to dark gray and gray-brown, are fissile, soft, and also contain traces of glauconite grains and pellets and pyrite inclusions.

In the interval 2058' to 2107' (top of the Upper Barrow sandstone), there is an increase in sandstone interbeds, but only two attain thicknesses up to 4'. One at 2058-2062', which had no shows, was very fine grained, subangular, and clayey. The second was encountered in a drilling break at 2092' (driller's depth), and was circulated up at 2096'. Samples from

this interval contained a light gray to light tannish-gray, very fine to fine grained, subrounded to rounded, silty, argillaceous sandstone with a slight hydrocarbon show, and lignitic coal and wood fragments. Some coal chips were coated with a green mineral (glauconite?).

Core No. 4 (2096-2136') recovered the lower 13' of the sandstone, siltstone and shale sequence which is indicated on the sonic log at 2093-2107'. Hydrocarbon shows were observed in the sandstones of the 13' interval. The contact of the Upper Barrow sandstone (a secondary objective) has been picked at the base of a brown shale which occurs in the core at 2107.9-2109' (2105-2107' sonic log).

Upper Barrow sandstone: 2107-2172'

Twenty-three feet of the Upper Barrow sandstone were recovered in Core No. 4. These sandstones were light to medium brown, very fine to fine grained, glauconitic and contained hydrocarbon shows. Porosities for the Upper Barrow section of Core No. 4 ranged from 12.9% to 23.8%. Permeabilities averaged 10.2 millidarcies with the exception of two one-foot intervals which had 133 and 188 millidarcies. Three drill-stem tests were attempted over the intervals 2080-2136', 2095-2136', and 2105-2136'. The first two were miruns, the third (2105-2136') had a calculated rate of 500 MCFGPD (Appendix F). A production test of the Upper Barrow and a thin sandstone of the Kingak had a calculated recovery of 1.0 MMCFGPD.

From 2136' to 2165', sandstones, similar to those in Core No. 4, were interbedded with light brown to brownish-gray shales and siltstones. Thin zones of porosity (estimated up to 20%) were observed in the sandstones.

Core No. 5 (2165-2187') was taken in what was thought to be the Lower Barrow sandstone. It was not discovered until after the electric logs were run that the core was terminated immediately above the Lower Barrow. This core was primarily light brown to gray-brown, subangular, fine grained sandstone with porosities varying from 10.9% to 24.4% (Appendix E). Permeabilities were generally low.

The base of the Upper Barrow sandstone has been placed at 2172' (a brown shale at 2172.5' in the core) to correlate with other wells in the East Barrow Gas Field.

Sandstones of the Kingak Formation below 2172.5' (Core No. 5) are very similar to those of the Upper Barrow, but had, in addition, scattered fossil and wood fragments. Hydrocarbon shows were present throughout. The lower 4.9' (2180-2184.9') of recovered core appeared oil saturated and was fractured and shattered. Spotty accumulations of live oil were present on some fracture faces and this portion of the core exhibited bleeding oil. Core analysis and electric logs show that this zone is thin and water-wet.

Generally there is a thin shale bed overlying the Lower Barrow sandstone and it is indicated on the electric log at 2186-2188'. It was not present in the core or samples but may have been in the unrecovered portion of the core.

Lower Barrow sandstone: 2188-2208'

The Lower Barrow sandstone, the primary objective and main producing reservoir of the East Barrow Gas Field, is 20' thick in this well. It is a light brown and tan, fine grained friable sandstone, partially filled with clay. Scattered carbonaceous and glauconitic grains are present. Poor hydrocarbon shows were observed. The formation density porosity log shows that porosities vary from 15-18% and have calculated water saturations of 79-100% (Appendices C & D).

Below the Lower Barrow, the Kingak Formation, which appears to extend to total depth of the well,* is a zone of interbedded sandstones, siltstones and shales. The sandstones vary from buff to light tannish-gray, are very fine to fine grained, very clayey and contain scattered carbonaceous and glauconite grains. No hydrocarbon shows were observed. Interbedded siltstones are light gray to dark gray-brown, shaly, partly sandy and contain carbonaceous flakes. The shales are light brown to dark brownish-gray, fissile and carbonaceous.

A drill-stem test of the Lower Barrow sandstone and underlying rocks recovered 2090' of formation water (Appendix F, DST No. 4).

* Biostratigraphic studies were not made on this well but correlations with South Barrow No. 19 indicate that No. 15 was probably terminated in lower Jurassic rocks.

HYDROCARBON INDICATIONS

By use of a binocular microscope, ultra-violet light and hydrogen flame chromatograph, the samples from South Barrow Well No. 15 were monitored for hydrocarbon shows.

Shows were minimal in the Torok Formation, although Core No. 2 (1329-1389') had fair to good fluorescence and cut in chloroethane from very thin bedded and interlaminated sandstones and siltstones. No sandstones of substantial thickness were encountered to warrant testing.

Sandstones of the "Pebble Shale", although not exceeding 5' in thickness, began to show an increase in hydrocarbon shows. Gas readings up to 360 units were recorded on the chromatograph with bright yellow to light yellow fluorescence and instant bluish-yellow to light yellow streaming cut observed under the ultra-violet light and immersion in chloroethane. Because these sands were thin and relatively far apart, they were not tested.

Background gas increased from 20 units to 80 units at 1885' and remained relatively high throughout the upper part of the Kingak. Occasional higher readings up to 480 units were noted, but fluorescence and cut were not observed until the sandstones at 2092-2096' were drilled. These sandstones had light to dull yellow fluorescence and very slow dull yellow cut in the circulated drill cuttings, and had an increase in gas up to 280 units.

Sands of the Upper Barrow sandstone all showed varying degrees of hydrocarbon fluorescence and cut under the ultra-violet light, although gas readings were lower than those obtained in the overlying part of the Kingak Formation. They averaged 100 units throughout.

Two drill-stem tests, 2080-2136' and 2095-2136', were attempted with the packers failing on each. A third test, 2105-2136', was good and recovered preliminary rates of 300-500 MCFGPD on 20/64" choke (Appendix F). A production test was later performed through perforations at 2110-2151' and 2054-2064' (a thin sandstone in the Kingak), with a calculated recovery of 1.0 MMCFGPD on 5/16" choke (see History of Drilling, South Barrow Well No. 15, Husky Oil NPR Operations, Inc., September 1982, pages 3 & 4).

Porosities obtained from laboratory analysis of Core No. 4 (2096-2136') varied from 11.1% to 23.8% with an average of 13.7% for the upper 26' and 19.1% for the next underlying 10' recovered. Permeability was generally very low except for the interval 2122-2131', where permeability reached a maximum of 188 millidarcies for 1' at 2126' and averaged 41 millidarcies.

Core No. 5 (2165-2187') exhibited hydrocarbon shows throughout with the bottom 4.9' appearing oil saturated. As mentioned previously, porosities varied from 10.9-24.4%. Permeabilities were generally low, and water saturations were predominantly greater than 60%. The lower three feet of the 4.9' interval had good porosity and permeability. Porosities were 20.6% to 24.4% for this 3' zone and permeabilities of 216 and 335 millidarcies recorded.

Although some bleeding oil was observed at the wellsite, core analysis shows that this zone is water-wet (water saturations to 84%). The electric logs indicate that the 3' recovered in the core was approximately the total thickness of the good porosity-permeable interval.

The Lower Barrow sandstone which had poor hydrocarbon shows, was not cored but electric-log calculations indicate 15-18% porosity and 79-100% water saturation.

Drill-Stem Test No. 4 was taken over the interval 2188-2278' with a recovery of 2090' of formation water (Appendix F). A chloride content of 14,000 ppm and a resistivity of 0.29 ohms at 58° was obtained from the water recovered from the test tool sample chamber.

STRUCTURAL DATA

South Barrow Well No. 15 is located on the north flank, as indicated from prognosis, of a small east-trending structural high (Figure 3). Drilling showed that the well is located on the down-thrown side of a fault that passes between Wells Nos. 15 and 19. A correlation between the two wells shows that No. 15 is 155' lower than No. 19 at the top of the Upper Barrow sandstone. A correlation of the BHC sonic logs from the two wells indicates that the fault must be present in the upper 493' of Well No. 15. From points at 493' in No. 15 and 330' in No. 19, correlations are good downward through the Lower Barrow sandstone with very little change in total interval (2-4'). It is the opinion of this writer that the fault should be placed at approximately 490'.

The dipmeter shows a high northeast dip (55° decreasing to 30°) from surface to 370'. Readings are sparce from 370-500' but indicate an increase in dip in a southeast direction. From 500' to 940' there is a reversal of dip to a west and southwest direction with dips averaging approximately 20°. At 940-970' there is a short reversal to the northeast at 1° to 2° dip. Below 970', the general trend of dip is to the northwest although occasional reversals do occur. Dips average 2-6°. The writer feels that some of the reversals in dip are due to slump and fracturing, and some to possible crossbedding in the sandstone. Fractures and some slickensides were observed in all but one of the cores recovered.

It is also the writer's feeling that some of the steep dips above 370' can be attributed to movement associated with the fault placed at approximately 490'.

CONCLUSIONS

1. The South Barrow Well No. 15 is a gas producer from the Upper Barrow sandstone of the Kingak Formation.

2. Well No. 15 is the only well in the East Barrow Gas Field to produce from this zone at the present time.

3. Because of the location on the down-thrown side of a fault, and thus 87' to 155' lower than other wells in the field, the Lower Barrow sandstone (principal gas-producing zone in the East Barrow field) is below the gas-water contact and will only produce water.

PERTINENT DATA AND APPENDICES

APPENDIX

SUMMARY OF PERTINENT DATA *

WELL NAME:	South Barrow Well No. 15
API NO.:	50-023-20016
OPERATOR:	Husky Oil NPR Operations, Inc.
LOCATION:	2640' FEL, 990' FNL, protracted Section 23, T22N, R17W, Umiat Meridian, North Slope Borough, Alaska.
COORDINATES:	Latitude: 71°14'58.68"N Longitude: 156°20'42.13"W X = 694,843.94 Y = 6,309,541.29 Zone 6
ELEVATION:	7' Ground, 12' Pad, 30' Kelly Bushing
CASING:	13-3/8" @ 80' (driller) 9-5/8" @ 1514' 7" @ 2198'
DATE SPUDDED:	August 23, 1980
TOTAL DEPTH:	2,278 feet
DATE REACHED TOTAL DEPTH:	September 10, 1980
DATE RIG RELEASED:	September 18, 1980
STATUS:	Suspended gas well

LOGGING RECORD:

DIL/GR/SP	110-1509'
DLL/GR/MSFL/Caliper	1520-2278'
BHCS/GR/TTI	110-1503'
	1520-2280'
FDC/CNL/GR/Caliper	1520-2278'
FDC/GR/Caliper	1520-2278'
MLL/Caliper	1520-2278'
HDT Dipmeter	108-1510'
	1520-2280'
Mud Log	107-2277'
Computed Logs	
Saraband	2000-2260'
Dipmeter Arrow Plot	130-1497'
	1536-2276'

SIDEWALL CORES: None

CONVENTIONAL CORES:

No.	Interval	Recovery	Formation
1	800- 825'	9.0'	Torok
2	1329-1389'	59.0'	Torok
3	1838-1881'	42.8'	"Pebble Shale"
4	2096-2136'	36.2'	Upper Barrow
5	2165-2187'	19.9'	Upper Barrow

DRILL-STEM TESTS: DST No. 1, 2080-2136', Misrun
DST No. 2, 2095-2136', Misrun
DST No. 3, 2105-2136', Recovered 500 MCFGPD
DST No. 4, 2188-2278', Recovered 2090' mud and water.

PRODUCTION TEST: Perf. 2054-2064', 2110-2151', flowed 1.0 MMCFGD

WELLSITE GEOLOGIST: R. G. Brockway

WELL LOG ANALYST: Armour Kane

CONTRACTOR: Brinkerhoff Signal, Inc.

MUD LOGGERS: Borst & Giddens Logging Service, Inc.

* Other available data:

Gearhart-Owen Pressure Data
(Hewlett-Packard)

SOUTH BARROW WELL NO. 15
DRILL CUTTINGS AND CORE DESCRIPTIONS
BY
R. BROCKWAY - 110-2278'

DEPTH DRILLED (FEET BELOW KELLY BUSHING)	
0 - 110	No recovery.
110 - 200	Siltstone: light tannish-gray with very fine to medium sand grains, coal chips, scattered light and dark chert pebbles and chips, clayey, fossil fragments, pelecypods, Inoceramus, stringers of light tannish-gray claystone, increasing at 180-200'.
200 - 210	Sandstone: light tannish-gray, subangular, medium sorted, silty, clayey, fossiliferous.
210 - 227	Siltstone: light tannish-gray, sandy, fossil fragments.
227 - 377	Sandstone: light to medium gray, very fine grained, partly fine grained, medium sorted, subangular, slightly carbonaceous, partly very carbonaceous on bedding planes, very calcareous, micaceous, scattered fossils, tight; no shows, thin interlaminated brownish-gray, very argillaceous, limestone with scattered pyrite crystals and inclusions, approximately 40% limestone.
377 - 418	Sandstone: light gray, medium grained, scattered coarse and very coarse grains, subangular to subrounded, poorly sorted, very soft and clayey, very calcareous streaks below 400'.
418 - 630	Sandstone: gray, light gray, "salt and pepper", very fine to fine grained, subangular, medium sorted, partly silty, very calcareous to moderately calcareous, rare green grains, a few siltstone and shale partings, tight to very slightly porous; no shows, rare limestone nodule, becoming highly fractured with crystalline calcite filling, increasing limestone at 600-630'.
630 - 800	Sandstone: very light gray to gray, fine to very fine grained, subangular, some subrounded grains, silty streaks, carbonaceous, slightly micaceous, very calcareous, scattered green grains, chlorite(?), argillite grains, pyrite inclusions, fractures with calcite filling, tight; no shows, interlaminated Limestone: gray-brown, very argillaceous, slightly silty, decreases downward from 35% to trace at 780-800'; increasing Siltstone laminations:

gray, calcareous to limy, appears to grade from limestone to siltstone, rare chert pebble.

800 - 825 Core No. 1: Cut 25', Recovered 9'

800.0-809.0' (9.0') Shale: brownish-gray, very soft, partly flaky to slightly fissile, micromicaceous, some very silty streaks with clayey siltstone inclusions, rare, very fine sandstone inclusions and partings, gummy when wet, apparent bedding dips range from 18-30°, 50° fracture with slickensides 803-804'.

809.0-825.0' (16.0') No recovery.

825 - 840 Claystone: light tannish-gray, very soft, silty with interbedded Sandstone: light gray, gray, "salt and pepper", subangular, fine to very fine grained, calcareous, tight; no shows, and Siltstone: gray, calcareous, partly clayey. Very poor sample.

840 - 900 No returns.

900 - 1329 Very poor samples, all going into suspension, drilling mud of very high percentage of silt-size grains; interval probably composed of very soft clayey siltstone and/or very silty claystone with occasional sandstone beds and laminations.

1329 - 1389 Core No. 2: Cut 60', Recovered 59'

1329.0-1345.0' (16.0') Shale: gray-brown, micromicaceous, soft, silty, slightly carbonaceous, very thin bedded and interlaminated with Siltstone: brown, micaceous, very soft, and Sandstone: very fine to fine grained, subangular, very soft, shaly, silty, slightly micaceous, rare glauconite grains, partly distorted with lenses and pods of each lithology; bright yellow fluorescence in sandstone and some siltstone, blue-yellow streaming cut, good hydrocarbon odor, beds up to 6", 50° fracture at 1340', fractured 1341-1342'.

1345.0-1360.0' (15.0') Shale: dark brown, micromicaceous, fissile, "poker chip", silty, thin very fine grained siltstone laminations and partings, rare very fine grained

	sandstone partings; no fluorescence, very faint light yellow cut, increasing sandstone laminations at 1357'.
1360.0-1361.0' (1.0')	Shale, Siltstone and Sandstone: finely laminated, dark to light brown, slightly carbonaceous, bright yellow fluorescence in sandstone, bluish-yellow streaming cut, good odor.
1361.0-1363.0' (2.0')	Sandstone: dark to light brown, fine to very fine grained, subangular, medium sorted, very shaly, silty, carbonaceous, shale and siltstone laminations, slightly porous streaks, faint light yellow fluorescence, instant light yellow cut, good odor.
1363.0-1365.0' (2.0')	Shale: dark brown, micromicaceous, thinly interbedded with Siltstone: dark brown, micaceous, partly sandy, carbonaceous, slight hydrocarbon odor.
1365.0-1370.0' (5.0')	Shale: dark brown, fissile, "poker chip", in part slightly silty, very finely micaceous, very thin sandstone and siltstone partings.
1370.0-1374.0' (4.0')	Siltstone: dark brown, very shaly, micaceous, in part slightly sandy, rare sandstone partings.
1374.0-1388.0' (14.0')	Shale: dark brown, slightly micromicaceous, fissile, siltstone laminations and partings with slight fluorescence and cut.
1388.0-1389.0' (1.0')	No recovery.
1389 - 1510	Very poor samples, predominantly buff-colored mud, with a very high percentage of silt-size grains; sandstone and rock fragments common.
1510 - 1580	Shale: brownish-gray to dark gray, fissile to flaky, carbonaceous, some bentonite streaks, scattered "floating" rounded quartz grains and chert pebbles, trace of brownish-gray limestone 1510-1530'.
1580 - 1838	Shale: medium to dark gray to dark brown, fissile, partly silty, carbonaceous streaks, thin bentonite

stringers, with interbedded and interlaminated Siltstone: brownish-gray to dark gray, partly carbonaceous, and Sandstone: light brownish-gray to medium gray, subangular to subrounded, argillite and dark chert grains common, porosity varies 0-15% (estimated), bright yellow to medium yellow fluorescence, instant to medium fast bluish-yellow to light yellow streaming cut, slight brown stain; 280-640 units of gas; sandstone beds reach 5' in thickness, average 2-3'.

1838 - 1881 Core No. 3: Cut 43', Recovered 42.8'

1838.0-1843.5' (5.5')	Siltstone: dark brown, shaly, sandy, rare inclusions of rounded, fine to coarse grained sandstone, pyrite replaced plant remains, rare glauconite, micaceous, a few shale partings, scattered rounded to subrounded chert and quartz grains and dark chert pebbles, pelecypod casts; no fluorescence or cut, slight odor.
1843.5-1844.0' (0.5')	Sandstone: dark brown, subangular, medium sorted, very silty and shaly, micaceous, rare glauconite, carbonaceous, tight, fair hydrocarbon odor; no fluorescence, very slow dull yellow cut, grades to siltstone.
1844.0-1845.8' (1.8')	Siltstone: dark brown, very sandy, shaly, micaceous, scattered medium to very coarse rounded quartz grains, rare greenish-black glauconite pellet, very slight odor.
1845.8-1848.0' (2.2')	Sandstone: dark brown, very fine grained, subangular, medium sorted, very silty, shaly, micaceous, scattered black carbonaceous grains, some subrounded, very coarse to medium quartz and dark chert grains, rare glauconite, rare dark brown shale inclusions, rare glauconite pellets, grades to siltstone.
1848.0-1850.8' (2.8')	Siltstone: dark brown, as above, some sandstone and shale inclusions, rare fish teeth, scattered rounded quartz and chert grains.

1850.8-1851.7' (0.9')	Sandstone: brown, oil stained, fine grained, subangular, medium sorted, very carbonaceous at top, black carbonaceous grains, argillite grains, 10% (estimated) porosity, light yellow fluorescence, instant bluish-yellow cut, fair odor.
1851.7-1863.0' (11.3')	Siltstone: dark brown, very sandy, micaceous, shaly, carbonaceous, a few pyrite inclusions, scattered rounded to subrounded, medium to very coarse quartz and chert grains, and dark chert pebbles, very spotty dull gold fluorescence, very slow yellow cut, good odor in upper 2', wet hydrocarbon stain on bedding plane at 1852.7', bleeding gas.
1863.0-1864.0' (1.0')	Shale: dark brown, fissile, micaceous, silty, slightly carbonaceous, pyrite replaced plant fragments, trace of crinoids(?), scattered rounded quartz grains and dark chert pebbles.
1864.0-1866.0' (2.0')	Siltstone: dark brown, shaly, sandy, very large fine crystalline pyrite inclusions, micaceous, scattered rounded to subrounded quartz and chert grains, rare pebble.
1866.0-1868.2' (2.2')	Siltstone: dark brown, very fine grained, subangular, medium sorted, very silty, shaly, carbonaceous, slightly micaceous, rare pyrite inclusion, rounded chert and quartz granules and grains, tight; no fluorescence, very slow dull yellow crush cut.
1868.2-1869.0' (0.8')	Siltstone: dark brown, sandy, shaly, micaceous, very coarse to coarse quartz and chert grains.
1869.0-1871.0' (2.0')	Sandstone: dark brown, very fine to fine grained, poorly sorted, slightly conglomeratic with dark chert and quartz pebbles, very silty, shaly, siltstone laminae, micaceous, tight; no show.
1871.0-1872.0' (1.0')	Siltstone: as above.

1872.0-1880.8' (7.8')	Shale: gray-brown, partly silty, fissile, slightly pyritic, micaceous, fish fragments common.
1880.8-1881.0' (0.2')	No recovery.
1881 - 1895	Shale: gray-brown, carbonaceous, fissile, pyrite inclusions, "floating" rounded quartz grains.
1895 - 1905	Conglomerate: rounded to subangular, chert and quartz pebbles, black, light gray, white, clear, with gray-brown silty clay matrix, tight, soft, trace of pyrite.
1905 - 1912	Shale: gray-brown, fissile, carbonaceous.
1912 - 1929	Siltstone: light brownish-gray, soft, clayey, carbonaceous, becoming tan, very clayey, slightly to moderately calcareous, scattered glauconite grains, interbedded Claystone: tan, silty.
1929 - 1974	Claystone: tan, silty, with interbedded Siltstone: as above, rare glauconite grain.
1974 - 1995	Shale: light to medium gray, light brownish-gray, fissile, soft, slightly carbonaceous, rare glauconite, with Siltstone: light gray, light tannish-gray, clayey, carbonaceous flakes.
1995 - 2080	Shale: gray-brown, dark gray, fissile, soft, slightly carbonaceous, partly light gray-brown, pyrite inclusions, with light brownish-gray to medium gray siltstone, slightly carbonaceous, trace of glauconite pellets and grains.
2080 - 2094	Claystone: light gray, very soft, sandy, silty, trace pyrite inclusions, with Shale: as above.
2094 - 2096	Coal: black, lignitic, large carbonaceous chips with rounded quartz grains and chert granules, and Sandstone: light gray, light tannish-gray, very fine grained, subrounded to subangular, argillaceous, glauconitic.
2096 - 2136	<u>Core No. 4: Cut 40', Recovered 36.2'</u>
2096.0-2098.3' (2.3')	Sandstone: fine to very fine grained, subangular, medium sorted, abundant glauconite grains and pellets, micaceous, tight, spotty light yellow fluorescence, very faint crush cut, fair odor.

2098.3-2101.0' (2.7')	Siltstone: medium to light brown, very sandy, shaly, abundant glauconite grains and pellets, scattered pyrite replaced plant fragments; no fluorescence, very faint cut.
2101.0-2103.0' (2.0')	Sandstone: light to dark brown, very fine to fine grained, subangular to subrounded, silty, shaly streaks, tight, light colored streaks, have light yellow fluorescence, very light yellow streaming cut, large pyritized wood fragment.
2103.0-2104.0' (1.0')	Siltstone: brown, sandy, shaly, pyritic plant remains, glauconitic, spotty bleeding oil and gas.
2104.0-2107.9' (3.9')	Sandstone: light to medium brown, fine grained with very fine grained streaks, subangular to subrounded, medium sorted, shaly, silty, quartzose, glauconitic, shale partings, porosity 0-7% (estimated), light brown stain, bright yellow fluorescence, instant light yellow cut, good odor.
2107.9-2109.0' (1.1')	Shale: medium brown, very sandy, silty, micaceous, sandy laminations, bleeding oil and gas.
2109.0-2118.5' (9.5')	Sandstone: light to medium brown, fine to very fine grained, subangular to subrounded, shaly streaks, slightly silty, clayey, trace of mica, quartzose, glauconitic, predominantly tight, streaks with estimated 0-10% porosity, scattered pyrite crystals, banded pale to bright yellow fluorescence, moderately fast to instant pale yellow to bluish-yellow cut, trace light brown cut without black light (2116-2118').
2118.5-2120.5' (2.0')	Sandstone: medium brown, fine to very fine grained, subangular, medium sorted, clayey to very shaly, quartzose, glauconitic, spotty dull yellow fluorescence, slight medium yellow cut, spotty bleeding oil and gas.
2120.5-2122.0' (1.5')	Sandstone: medium brown, very fine to fine grained, subangular, quartzose,

glauconitic, shale partings, becoming very shaly at 2121', porosity streaks estimated to 10%, dull yellow fluorescence, instant faint yellow cut, spotty bleeding oil and gas.

2122.0-2131.3' (9.3') Sandstone: medium brown, very fine to fine grained, subangular to subrounded, medium sorted, clayey, slightly silty, quartzose, glauconitic, partly shaly, occasional carbonaceous grain, rare micaceous, porosity 8-15% (estimated), dull to medium yellow fluorescence, moderately fast medium yellow to instant bluish-yellow cut, faint light brown cut without black light, 70° fracture at 2130', trace of bedding planes 15°.

2131.3-2132.2' (0.9') Siltstone: brownish-gray, micaceous, shaly, slightly carbonaceous, rare pyrite replaced plant remains.

2132.2-2136.0' (3.8') No recovery.

2136 - 2165 Sandstone: light brownish-gray to light brown, very fine grained, subangular to subrounded, clayey, silty, tight, glauconitic, interbedded with Shale: light gray-brown to dark brown, soft, fissile, rare carbonaceous grains, and Siltstone: light brown to medium gray-brown, shaly.

2165 - 2187 Core No. 5: Cut 22', Recovered 19.9'

2165.0-2167.0' (2.0') Sandstone: light gray to gray-brown, shaly, slightly to moderately calcareous, very fine grained, subangular, quartzose, carbonaceous flakes and grains, rare glauconite, tight, very faint spotty dull yellow fluorescence, very faint light yellow cut, core breaks horizontally.

2167.0-2169.0' (2.0') Sandstone: brownish-gray, subangular, medium sorted, very shaly, moderately soft, slightly carbonaceous, very slightly calcareous, trace of mica, rare glauconite; no fluorescence, very slight medium yellow cut, crossbedding or fracture at 15°, highly shattered 2168-2169'.

2169.0-2172.5' (3.5')	Sandstone: light brown, fine grained subangular, medium sorted, quartzose, carbonaceous flakes and grains, glauconitic, slightly calcareous, argillaceous, estimated 20% porosity, good odor, light brown stain, faint yellow fluorescence, instant bluish-yellow cut; core breaks horizontally.
2172.5-2174.0' (1.5')	Shale: dark brown, micaceous, carbonaceous, soft, silty, very sandy, slightly carbonaceous, rare fossil fragments.
2174.0-2177.5' (3.5')	Sandstone: light gray-brown to very light brown, very fine to fine grained, subangular, medium to well sorted, quartzose, shaly to clayey, rare glauconite, faint pale yellow fluorescence, instant pale yellow cut, estimated 5-8% porosity, 85° fracture at 2174-2175', slightly open, no coating or stain on surface; core shattered at 2176.4-2177.0'.
2177.5-2179.0' (1.5')	Sandstone: gray-brown, fine grained subangular, medium sorted, quartzose, shaly, to clayey, rare shale parting, glauconitic, carbonaceous, tight to 10% porosity (estimated), large pyritic and coaly plant remains, scattered fossil fragments; core broken on 45° angle, 60° closed fracture.
2179.0-2184.9' (5.9')	Sandstone: brown, gray-brown, fine grained, subangular, well sorted, glauconitic, quartzose, slightly carbonaceous, friable, oil stained, dull yellow to pale light yellow fluorescence, instant pale yellow cut, porosity estimated 10-20%, lower 5' of core saturated with oil, fractured and shattered, spots of dark brown heavy live oil on some fractures, core bleeding some dark brown oil, scattered fossil fragments; large wood fragment 2183-2184'.
2184.9-2187.0' (2.1')	No recovery.

2187 - 2278	Sandstone: tan, light brown, fine grained, subangular, medium sorted, quartzose, friable, some clay matrix, scattered glauconite and carbonaceous grains, fossil fragments, streaks with good porosity, spotty pale yellow fluorescence, very faint cut. Some light brown to gray-brown siltstone and shale.
2200 - 2210	Sandstone: as above and Shale (40%): light brown to dark brownish-gray, fissile, carbonaceous, trace of pyrite replaced plant fragments.
2210 - 2240	Sandstone: light tannish-gray, very fine to fine grained, subangular to subrounded, medium sorted, soft, clayey, black carbonaceous and rare glauconite grains, large carbonaceous chips, no show. Interbedded brownish-gray siltstone and shale, as above.
2240 - 2250	Siltstone: brownish-gray, carbonaceous, soft, and Shale: dark brownish-gray, fissile, carbonaceous, partly silty, scattered chert granules.
2250 - 2278	Sandstone: tan to light tannish-gray, very fine to fine grained, subangular to surounded, clayey, slightly sideritic, soft, scattered fossil fragments, some porous streaks. Interbedded Shale: as above, and Siltstone: brownish-gray to light gray, slightly carbonaceous, partly sandy.

2,278 Feet Total Depth

Log Analysis

ARMOUR KANE
Well Log Analyst
18360-6 Cantara St
Reseda, Ca 91335
(213) 993-0586

Formation Evaluation

September 16, 1980

Mr. S. L. Hewitt
Husky Oil/NPR Operations, Inc.
2525 C Street
Anchorage, Ak 99503

Dear Mr. Hewitt:

Schlumberger began logging operations on Barrow No. 15 at 2100 hours September 10, 1980, and after a clean-out run because of a bridge at 2132 feet, finished DLL, BHC, CNL/FDC, MLL/ML and HRD at 1600 hours, September 11, 1980. Log quality was good except that an SP curve could not be obtained on the DLL and the BHC is a little questionable although ϕ_s and ϕ_n correlate rather well. The difference between two, three and four arm calipers is quite marked but the HRD calipers confirm the others. No lost time due to tool failure or human error was encountered.

Log tops were: Kingak at 1698 as compared to 1716 in Barrow 19; Upper Barrow sand at 2109, 1948 in Barrow 19, and Lower Barrow sand at 2188, 2018 in Barrow 19. Correlations were good.

Well-site manual computations of quantitave analysis indicate that the Lower Barrow sand is completely water-bearing. The Rw_a value from a comparison of ϕ_D and R_t is about 0.15 which translates to a salinity of 40,000 ppm which I believe is too high, I believe it should be in the order of 25,000 to 30,000 ppm. Based on an Rw_a of 0.15 this would make two intervals, 2130-40 and 2180-90, possibly productive with indicated water saturations in the order of 50%. However, if Rw is greater than 0.15 the Sw values would be higher making the intervals more pessimistic. These calculations are of course less refined than Saratband results.

Very truly yours,

A. Kane

Log Analysis

COMPANY: HUSKY OIL/NPR OPERATIONS, INC.
WELL: S. BARROW 15
FIELD: NORTH SLOPE
COUNTY:
STATE: ALASKA

DEPTH	RT	ϕ_D	ϕ_N	ϕ_S	R_{wa}	S_w	REMARKS
2112-28	12	14	28	25	.27	74	
2130-40	14	19	25	26	.60	50	
2140-50	15	17	28	30	.52	53	
2150-60	12	17	28	28	.40	61	
2190-94	6	18	31	27	.24	79	
2194-2200	6	15	31	28	.15	100	

HUSKY OIL NPR OPERATIONS INC.
U.S. GEOLOGICAL SURVEY ONPRA

LOGGING REPORT

BARROW #15

9/10, 11, 1980 — Driller Depth: 2278'

30' KB — Logger Depth: 2279'

DLL/GR/CAL 1520-2278'
BHCS/GR 1520-2280'
CNL/FDC/GR/CAL 1520-2280'
HRD Dipmeter 1520-2278'
MLL/ML 1520-2280'

[illegible]	Gross Thickness	Net Feet of Porosity	Lith	Avg. Porosity	S_w	Probable Fluid Content
2112-2128'	16	16	Ss	14	76	Gas & Water
2130-2140'	10	10	Ss	19	50	" "
2140-2150'	10	10	Ss	17	54	" "
2190-2194'	4	4	Ss	18	79	" "
2194-2200'	6	6	Ss	15	100	Water

Discussion

Above S_w values based on R_w = 0.15 from FDC porosities.
BHCS responses somewhat questionable, especially the caliper.

Log Tops & Correlations

	BARROW #15	BARROW #19
KINGAK	1898'	1716'
UPPER BARROW SD	2109'	1948'
LOWER BARROW SD	2188'	2108'

RON BROCKWAY

A. KANE

USGS/HUSKY OIL COMPANY, OPR.
SOUTH BARROW NO. 15
SOUTH BARROW
NORTH SLOPE, ALASKA

DATE : 11-SEP-80
FORMATION :
DRLG. FLUID: WBM
LOCATION :

FILE NO : BP-3-612
ANALYSTS : WSF,TLS
LABORATORY: ANCHORAGE

CORE ANALYSIS RESULTS (Nos. 4 and 5)

Core No. 4

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY (MD) MAXIMUM	90 DEG	VERTICAL	POR %	GRAIN DEN.	FLUID SATS. OIL	WTR	DESCRIPTION
1	2096.0	0.26			13.6	2.67	3.9	77.4	ssivfgr slty cly
2	2097.0	0.30			12.9	2.68	4.4	73.9	same
3	2098.0	0.26			12.9	2.67	6.2	79.9	same
4	2099.0	0.22			12.4	2.67	4.8	78.3	same
5	2100.0	0.11			11.1	2.68	4.9	74.4	same
6	2101.0	1.41			14.7	2.66	6.3	70.7	same
7	2102.0	0.16			12.9	2.68	7.1	67.7	same
8	2103.0	0.15			11.6	2.68	14.2	66.8	same
9	2104.0	1.53			15.0	2.66	10.4	70.1	same
10	2105.0	0.94			13.0	2.69	10.1	71.7	same
11	2106.0	1.91			13.9	2.68	9.1	63.8	same
12	2107.0	0.51			13.8	2.66	9.9	70.8	same
13	2108.0	0.28			13.4	2.67	6.0	80.0	same
14	2109.0	0.36			13.0	2.67	5.6	77.7	same
15	2110.0	2.27			16.5	2.65	8.0	72.4	same
16	2111.0	0.46			13.5	2.66	10.3	67.6	same
17	2112.0	0.80			13.1	2.69	9.3	64.9	same
18	2113.0	0.84			13.7	2.66	9.9	66.3	same
19	2114.0	1.30			15.7	2.65	5.2	75.3	same
20	2115.0	1.04			15.2	2.65	10.0	64.2	same
21	2116.0	4.05			15.2	2.65	9.0	73.3	same
22	2117.0	5.83			14.8	2.67	11.1	69.3	same
23	2118.0	2.30			15.2	2.66	11.5	60.2	same
24	2119.0	0.28			12.9	2.71	10.9	61.3	same
25	2120.0	0.45			13.2	2.65	11.5	72.3	same
26	2121.0	1.90			13.1	2.66	13.9	66.6	same
27	2122.0	3.53			16.5	2.65	15.9	58.5	same
28	2123.0	5.92			16.6	2.65	11.6	63.2	same

USGS/HUSKY OIL COMPANY, OPR.
SOUTH BARROW NO. 15

DATE : 11-SEP-80
FORMATION :

FILE NO : BP-3-612
ANALYSTS : WSF,TLS

CORE ANALYSIS RESULTS (Nos. 4 and 5)

Core No. 4

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY (MD) MAXIMUM	90 DEG	VERTICAL	POR %	GRAIN DEN.	FLUID SATS. OIL	WTR	DESCRIPTION
29	2124.0	10.			18.5	2.65	11.6	57.5	same
30	2125.0	4.60			17.3	2.65	14.4	59.8	same
31	2126.0	188.			23.5	2.65	18.0	60.5	same
32	2127.0	13.			17.4	2.65	14.5	56.7	same
33	2128.0	27.			20.0	2.65	13.5	56.5	same
34	2129.0	21.			19.5	2.89	8.3	39.8	same
35	2130.0	133.			23.8	2.65	17.5	46.9	same
36	2131.0	4.44			17.9	2.66	2.1	84.2	same
37	2165.0	1.46			15.7	2.66	6.7	65.3	same
38	2166.0	1.95			10.9	3.10	6.4	61.0	same;sid
39	2167.0	8.35			17.4	2.66	6.7	65.6	ss;vfgr slty cly
40	2168.0	19.			18.8	2.66	5.2	59.5	same
41	2169.0	2.38			16.2	2.65	7.6	58.6	same
42	2170.0	177.			24.2	2.65	18.4	42.9	ss;vf-fgr slty sl cly
43	2171.0	24.			19.3	2.65	4.9	61.8	same
44	2172.0	1.33			15.4	2.67	3.9	69.2	ss;vfgr slty cly
45	2173.0	9.20			16.7	2.66	5.0	69.5	same
46	2174.0	2.00			14.6	2.66	6.9	66.4	same
47	2175.0	9.09			17.6	2.65	4.4	79.9	same
48	2176.0	13.			18.9	2.65	4.9	73.8	same
49	2177.0	21.			18.8	2.65	1.0	71.4	same
50	2178.0	29.			21.0	2.64	0.5	74.4	same
51	2179.0	1.33			14.6	2.65	6.9	63.9	same
52	2180.0	1.33			15.8	2.66	4.0	77.7	same
53	2181.0	13.			16.1	2.71	17.7	58.4	same;sc sid
54	2182.0	216.			24.0	2.63	16.9	59.0	ss;f-mgr slty sl cly
55	2183.0	335.			24.4	2.64	5.4	80.7	same
56	2184.0				20.6	2.68	3.9	84.0	same *sum. fluid analysis*

Core No. 5

HUSKY OIL NPR OPERATIONS, INC.
U.S. GEOLOGICAL SURVEY/ONPRA

HUSKY

DRILL STEM TEST REPORT FORM

WELL NAME BARROW #15 DST. NO. 1 (misrun) DATE 9-7-80

Formation Tested Upper Barrow Sd.

Hole Size 8 1/2"

Test Interval 2080-2136'

Drill Collar Length _____ I.D. _____

Total Depth 2136'

Drill Pipe Length _____ I.D. _____

Choke Size:
Surface _____ Bottom Hole _____

Packer Depth(s) 2080 Ft.

Depth Tester Valve _____ Ft.

Cushion Type None Amount _____

TEST DATA

Tool open at Approx 0800 hrs.
Initial flow period _____ min.
Initial shut-in period _____ min.
Final flow period _____ min.
Final shut-in period _____ min.
Unseated packers _____ hrs.

RESISTIVITY-CHLORIDE DATA

	Resistivity		Chloride Content
Recovery Water	None @	°F.	ppm
Recovery Mud	@	°F.	ppm
Recovery Mud Filtrate	@	°F.	ppm
Mud Pit Sample	@	°F.	ppm
Mud Pit Sample Filtrate	@	°F.	ppm

Mud Weight 10.2 vis 41 cp

Description of initial flow period Packers failed after approx 3 min of initial open; no pressures recorded

Description of final flow period

PRESSURE DATA

TEMPERATURE	Gauge No. / Depth: ft.	Gauge No. / Depth: ft.	Gauge No. / Depth: ft.	TIME
	Hour Clock	Hour Clock	Hour Clock	Tool Opened A.M. / P.M.
Est. °F	Blanked Off	Blanked Off	Blanked Off	
Actual °F	Pressures	Pressures	Pressures	Opened Bypass A.M. / P.M.
	Field / Office	Field / Office	Field / Office	Reported Minutes / Computed Minutes
Initial Hydrostatic				
First Period FLOW Initial				— —
First Period FLOW Final				
First Period Closed In				
Second Period FLOW Initial				— —
Second Period FLOW Final				
Second Period Closed In				
Third Period FLOW Initial				— —
Third Period FLOW Final				
Third Period Closed In				
Final Hydrostatic				— —

RECOVERY DATA

Cushion	Type	Amount	Depth Back Pres. Valve	Surface Choke	Bottom Choke	Mud From Tester Valve
Recovered		Feet obl of				
Recovered		Feet obl of				
Recovered		Feet obl of				
Recovered		Feet obl of				

Remarks Misrun

Prepared by RON BROCKWAY

HUSKY

HUSKY OIL NPR OPERATIONS, INC.
U.S. GEOLOGICAL SURVEY/ONPRA

DRILL STEM TEST REPORT FORM

WELL NAME BARROW #15 DST. NO. 2 (misrun) DATE 9-7-80

Formation Tested UPPER BARROW SD

Hole Size 8 1/2"

Test Interval 2095-2136'

Drill Collar Length 528.74 I.D. 2.25

Total Depth 2136'

D. P. Pipe Length - I.D. 2.602

Choke Size: Surface 1/8" & 1/4" Bottom Hole 3/4"

Packer Depth(s) 2095 Ft.

Depth Tester Valve - Ft.

Cushion Type None Amount

TEST DATA

Tool open at 1621 hrs.
Initial flow period approx. 22 min.
Initial shut-in period ____ min.
Final flow period ____ min.
Final shut-in period ____ min.
Unseated packer at (approx.) 1700 hrs.

RESISTIVITY CHLORIDE DATA

	Resistivity		Chloride Content
Recovery Water	None @ ____ °F.		____ ppm
Recovery Mud	____ @ ____ °F.		____ ppm
Recovery Mud Filtrate	____ @ ____ °F.		____ ppm
Mud Pit Sample	____ @ ____ °F.		____ ppm
Mud Pit Sample Filtrate	____ @ ____ °F.		____ ppm
Mud Weight 10.2	vis 41		cp

Description of initial flow period Opened with immediate mod blow increasing to strong blow in 11 min w/SFP of 360 psi thru 1/8" choke, SFP declined to 350 psi in 16 min, further declined to 220 psi in 23 min and 50 psi in 34 min.

Description of final flow period

PRESSURE DATA

TEMPERATURE	Gauge No. / Depth ft	Gauge No. / Depth ft	Gauge No. / Depth ft	TIME
Est. °F	Hour Clock / Blanked Off	Hour Clock / Blanked Off	Hour Clock / Blanked Off	Tool Opened A.M. / P.M.
Actual °F	Pressures: Field / Office	Pressures: Field / Office	Pressures: Field / Office	Opened Bypass A.M. / P.M.
				Reported Minutes / Computed Minutes
Initial Hydrostatic				
First Period FLOW Initial				
First Period FLOW Final				
First Period Closed In				
Second Period FLOW Initial				
Second Period FLOW Final				
Second Period Closed In				
Third Period FLOW Initial				
Third Period FLOW Final				
Third Period Closed In				
Final Hydrostatic				

RECOVERY DATA

			Depth Back Pres. Valve	Surface Choke	Bottom Choke	Mud Type
Cushion	None	Type Amount				
Recovered	None	Feet bbl of				
Recovered		Feet bbl of				
Recovered		Feet bbl of				
Recovered		Feet bbl of				

Remarks No fluid recovery on reverse out, well started to flow after reverse out.

RON BROCKWAY

PRELIMINARY

HUSKY

HUSKY OIL NPR OPERATIONS, IN
U.S. GEOLOGICAL SURVEY/ONPR

DRILL STEM TEST REPORT FORM

WELL NAME BARROW #15 DST. NO. 3 DATE 9-9-80

Formation Tested UPPER BARROW SD

Test Interval 2105-2136'

Total Depth 2136'

Choke Size 1/8", 24/64", Surface 20/64" Bottom Hole 3/4"

Hole Size 8 1/2"

Drill Collar Length 603.64 I.D. 2.25

Tool Length 74.9
Drill Pipe Length 1537.25 I.D. 2.602

Packer Depth(s) 2105' (top lower pkr) Ft.

Depth Tester Valve 2069' Ft.

Cushion Type None Amount

TEST DATA

Tool open at 1211 hrs 9-8-80 hrs.
Initial flow period 63 min.
Initial shut-in period 63 min.
Final flow period 122 min.
Final shut-in period 240 min.
Unseated packer at 2119 hrs 9-8-80 hrs.

RESISTIVITY/CHLORIDE DATA

	Resistivity			Chloride Content
Recovery Water	None	@	°F.	ppm
Recovery Mud		@	°F.	ppm
Recovery Mud Filtrate		@	°F.	ppm
Mud Pit Sample		@	°F.	45000 ppm
Mud Pit Sample Filtrate		@	°F.	ppm

Mud Weight 10.2 vis 41 cp

Description of initial flow period Opened w/immediate strong blow thru 1/8" choke, increase to v. strong blow in 2 min. w/SFP 400 psi, GTS in 4 min, SFP increase to 830 psi in 22 min and stabilized thru remainder of FP.

Description of final flow period Opened thru 24/64" choke w/SFP of 200 psi increasing to SFP 290 psi in 20 min and declined to 230 psi in 25 min, changed to 20/64" choke w/SFP 245 psi; SFP slowly declined to 200 psi at end of FP. Calculated final flow rate approx. 500 MCFPD.

PRESSURE DATA

TEMPERATURE	Gauge No. 32, Depth: 2073 ft.	Gauge No. 329, Depth: 2077 ft.	Gauge No. 62, Depth: 2132 ft.	Gauge No. 13, Depth: 2136 ft.
	48 Hour Clock	48 Hour Clock	48 Hour Clock	48 Hour Clock
Est. °F	Blanked Off No	Blanked Off No	Blanked Off Yes	Blanked Off Yes
Actual °F	Pressures	Pressures	Pressures	Pressures
	Field / Office	Field / Office	Field / Office	Field / Office
Initial Hydrostatic	1163.1	1164.3	1178.1	1174.2
First Period FLOW Initial	113.5	165.4	253.0	251.2
First Period FLOW Final	928.0	932.0	946.6	938.5
First Period Closed In	952.0	956.1	965.8	970.5
Second Period FLOW Initial	255.3	257.7	296.7	295.2
Second Period FLOW Final	235.1	238.4	267.8	283.2
Second Period Closed In	944.0	961.0	965.8	962.5
Third Period FLOW Initial				
Third Period FLOW Final				
Third Period Closed In				
Final Hydrostatic	1147.8	1149.8	1178.1	1170.2

RECOVERY DATA

Cushion None	Type	Amount	Depth Back Pres. Valve	Surface Choke	Bottom Choke
Recovered		Feet/bbl of			
Recovered		Feet/bbl of			
Recovered		Feet/bbl of			
Recovered		Feet/bbl of			

Remarks Chromatograph analysis indicates 95% methane. After test, circulated out 3040 units gas.

No indication of water or hydrocarbon fluids in tools or during test.

Collected 3 gas spls during IFP and 1 gas sample during FFP.

RON BROCKWAY
Prepared by

PRELIMINARY

HUSKY OIL NPR OPERATIONS, INC.
U.S. GEOLOGICAL SURVEY/ONPRA

DRILL STEM TEST REPORT FORM

WELL NAME BARROW #15 DST. NO. 4 DATE 9-12-80

Formation Tested LOWER BARROW SS
Hole Size 8 1/2"

Test Interval 2188-2278'
Drill Collar Length 499.33 I.D. 2.25

Total Depth 2278'
Drill Pipe Length 1778.70 I.D. 2.76

Choke Size Surface 20/64" / 24/64" Bottom Hole 3/4"
Packer Depth(s) 2182-2188' Ft

Depth Tester Valve 2141 Ft.

Cushion Type None Amount N/A

TEST DATA

Tool open at 0329 hrs.
Initial flow period 61 min.
Initial shut-in period 120 min.
Final flow period 120 min.
Final shut-in period 240 min.
Unseated at 1230 hrs.

RESISTIVITY CHLORIDE DATA

	Resistivity		Chloride Content
Recovery Water	@ °F.		15,500 ppm
Recovery Mud	@ °F.		ppm
Recovery Mud Filtrate	@ °F.		ppm
Mud Pit Sample	@ °F.		ppm
Mud Pit Sample Filtrate	@ °F.	48,000	ppm

Mud Weight 10.3 vis 41 cp

Description of initial flow: Opened w/mod blow (90 psi surf pressure), decreased to weak blow TSTM in 30 min.; weak blow TSTM at shut in (no gas or fluid to surf).

Description of final flow: Opened with a weak blow TSTM, becoming v. weak in 8 min.; dead in one hour.

PRESSURE DATA

TEMPERATURE	Gauge No. 329 Depth 2136 ft.		Gauge No. 62 Depth 2274 ft.		Gauge No. 13 Depth 2278 ft.		TIME
	48 Hour Clock		48 Hour Clock		48 Hour Clock		Tool Opened A.M.
Est	Blanked Off No		Blanked Off Yes		Blanked Off Yes		Tool Opened P.M.
Actual							Bypass A.M.
Temp gauge 50-250° did not register	Pressures		Pressures		Pressures		Bypass P.M.
	Field	Office	Field	Office	Field	Office	Reported Minutes / Computed Minutes
Initial Hydrostatic	1179.0		1255.4		1246.1		
Initial FLOW Initial	141.1		229.1		222.9		
Initial FLOW Final	917.5		975.2		994.5		
Initial Closed In	946.5		1014.0		1026.4		
Final FLOW Initial	927.2		994.8		1006.4		
Final FLOW Final	956.0		1018.0		1018.4		
Final Closed In	956.0		1018.0		1070.3		
Final FLOW Initial							
Final FLOW Final							
Final Closed In							
Final Hydrostatic	1179.0		1245.7		1246.1		

RECOVERY DATA

		Type	Amount	Depth Back Pres Valve	Surface Choke	Bottom Choke
Cushion	None					
Recovered	2090		Feet xx of formation water			
Recovered			Feet bbl of			
Recovered			Feet bbl of			
Recovered			Feet bbl of			

Remarks: Broke off 1st 3 stands fluid approx 5' in upper stand; took spls from each stand, rec. 2090' water; reversed out spl #4 from half-way on reverse out; spls 5, 6, 7 from spl chamber.

RON BROCKWAY

CHEMICAL & GEOLOGICAL LABORATORIES, ALASKA, INC.

TELEPHONE (907) 279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

GAS ANALYSIS REPORT

Company Husky Oil Company Date September 22, 1980 Lab No 5030

Well No South Barrow No. 15 Location

Field Formation

County Depth

State Alaska Sampling Point DST

Line pressure psig, Sample pressure 350 psig, Temperature °F, Container number

Remarks

Recovered 57100 cc gas, 200 ml gas cut mud.

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	1.70	
Carbon dioxide	TRACE	
Hydrogen sulfide	—	
Methane	98.18	
Ethane	0.10	
Propane	0.02	0.005
Iso-butane & Higher	TRACE	TRACE
Total	100.00	0.005

GPM of pentanes & higher fraction

Gross btu cu. ft. @ 60° F. & 14.7 psia (dry basis) = 993

Specific gravity (calculated from analysis) = 0.565

Specific gravity (measured) 0.565

Remarks

CHEMICAL & GEOLOGICAL LABORATORIES ALASKA, INC.

TELEPHONE (907) 279-4014
274-3364
ANCHORAGE INDUSTRIAL CENTER
5633 B Street

GAS ANALYSIS REPORT

Company Husky Oil Company Date September 24, 1980 Lab No. 5108-1

Well No. South Barrow No. 15 Location

Field NPRA Formation Upper Barrow

County Depth

State Alaska Sampling Point DST No. 3

Line pressure ____ psig. Sample pressure ____ psig. Temperature ____ °F. Container number

Remarks Sample No. 3. Sample pressure when received 0 psig. Sample taken by water displacement. Insufficient sample for Helium determination.

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	2.14	
Carbon dioxide	0	
Hydrogen sulfide	—	
Methane	97.84	
Ethane	0.02	
Propane & Higher	TRACE	TRACE
Total	100.00	TRACE

GPM of pentanes & higher fraction

Gross btu cu ft @ 60° F. & 14.7 psia (dry basis) = 989

Specific gravity (calculated from analysis) = 0.563

Specific gravity (measured)

Remarks

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

TELEPHONE (907) 279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

GAS ANALYSIS REPORT

Company Husky Oil Company Date September 24, 1990 Lab No. 5108-2

Well No South Barrow No. 15 Location

Field NPRA Formation Upper Barrow

County Depth 2054-2151

State Alaska Sampling Point Production Test No. 2

Line pressure 250 psig. Sample pressure psig Temperature °F. Container number

Remarks Sample No. 6. Sample pressure when received 3 psig. Insufficient sample for helium determination.

Component	Mole % or Volume %	Gallons per MCF
Oxygen	0	
Nitrogen	1.66	
Carbon dioxide	TRACE	
Hydrogen sulfide	—	
Methane	98.25	
Ethane	0.08	
Propane	0.01	0.003
Iso-butane & Higher	TRACE	TRACE
Total	100.00	0.003

GPM of pentanes & higher fraction

Gross btu / cu ft @ 60° F. & 14.7 psia (dry basis) = 994

Specific gravity (calculated from analysis) = 0.561

Specific gravity (measured) = 0.560

Remarks

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907) 279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

ANALYTICAL REPORT

From Husky Oil Company — Product Drilling Mud Sample

Address Anchorage, Alaska — Date September 16, 1980

Other Pertinent Data

Analyzed by DB, KS — Date October 8, 1980 — Lab No. 5053

REPORT OF ANALYSIS
DRILLING MUD SAMPLE
DST NO. 2 (2095- 2136)
SOUTH BARROW NO. 15
NPRA, ALASKA

Sample received September 16, 1980

SAMPLE	CHLORIDE, mg/l
Mud from Reverse Out	50000

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907) 279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

WATER ANALYSIS REPORT

OPERATOR	Husky Oil Company	DATE	October 8, 1980
WELL NO.	South Barrow No. 15	LAB NO.	5053-2
FIELD	NPRA	LOCATION	
COUNTY		FORMATION	
STATE	Alaska	INTERVAL	DST No. 4 (2188-2278)
		SAMPLE FROM	1/2 way thru Reverse Out

REMARKS & CONCLUSIONS: Sample taken September 12, 1980 by Ron Brockway.

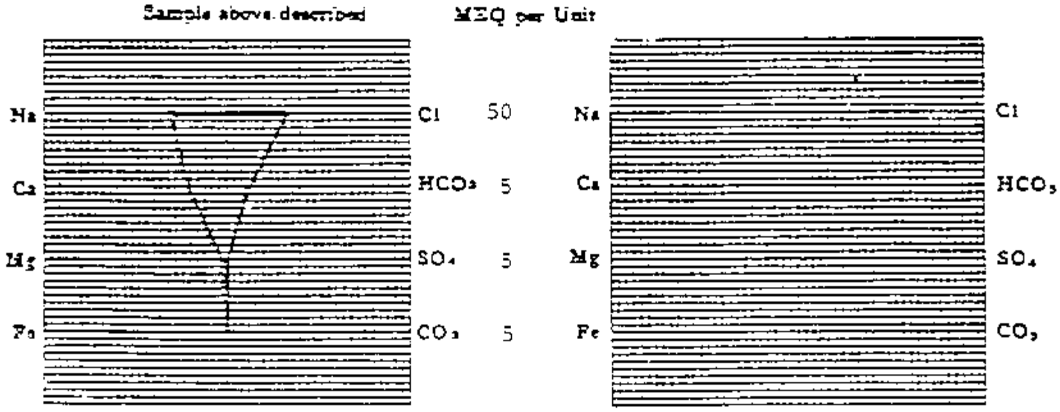
Cations	mg/l	meq/l	Anions	mg/l	meq/l
Sodium	8907	387.45	Sulfate	1	0.02
Potassium	40	1.02	Chloride	14400	406.08
Calcium	550	27.45	Carbonate	0	0
Magnesium	90	6.58	Bicarbonate	1000	16.40
Iron	–	—	Hydroxide	–	—
Total Cations		422.50	Total Anions		422.50

Total dissolved solids, mg/l	24475	Specific resistance @ 68°F.:		
NaCl equivalent, mg/l	24300	Observed	0.31	ohm-meters
Observed pH	7.0	Calculated	0.29	ohm-meters

WATER ANALYSIS PATTERN

Sample above described

Scale
MEQ per Unit



(Na value in above graphs includes Na, K, and Li)
NOTE: Mg/l = Milligrams per liter Meq/l = Milligram equivalents per liter
Sodium chloride equivalent = by Dunlap & Hawthorne calculation from components

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

P.O. BOX 4-1276
Anchorage, Alaska 99509

TELEPHONE (907) 279-4014
274-3364

ANCHORAGE INDUSTRIAL CENTER
5633 B Street

WATER ANALYSIS REPORT

OPERATOR	Husky Oil Company	DATE	October 8, 1980 LAB NO. 5053-3
WELL NO.	South Barrow No. 15	LOCATION	
FIELD	NPRA	FORMATION	
COUNTY		INTERVAL	DST No. 4 (2186-2278)
STATE	Alaska	SAMPLE FROM	Sample Chamber

REMARKS & CONCLUSIONS: Sample taken 9-12-80 by Ron Brockway

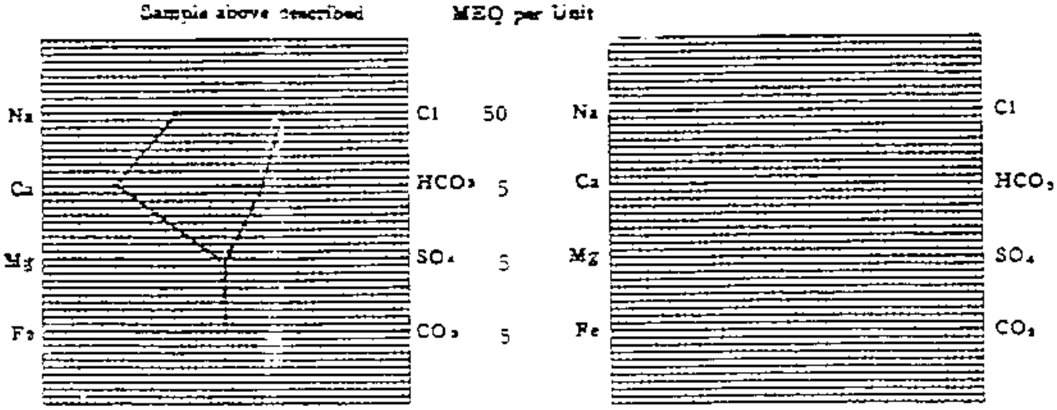
Cations	mg/l	meq/l	Anions	mg/l	meq/l
Sodium	7804	339.49	Sulfate	2	0.04
Potassium	43	1.10	Chloride	14000	394.80
Calcium	1465	73.10	Carbonate	0	—
Magnesium	69	5.59	Bicarbonate	1490	24.44
Iron	—	—	Hydroxide	—	—
Total Cations		419.28	Total Anions		419.28

Total dissolved solids, mg/l	24120	Specific resistance @ 68°F.:	
NaCl equivalent, mg/l	23778	Observed	0.29 ohm-meters
Observed pH	7.1	Calculated	0.29 ohm-meters

WATER ANALYSIS PATTERN

Sample above described

Scale
MEQ per Unit



(Na value in above graphs includes Na, K, and Li)
NOTE: Mg/l = Milligrams per liter Meq/l = Milligram equivalents per liter
Sodium chloride equivalent = by Dunlap & Hawthorne calculation from components